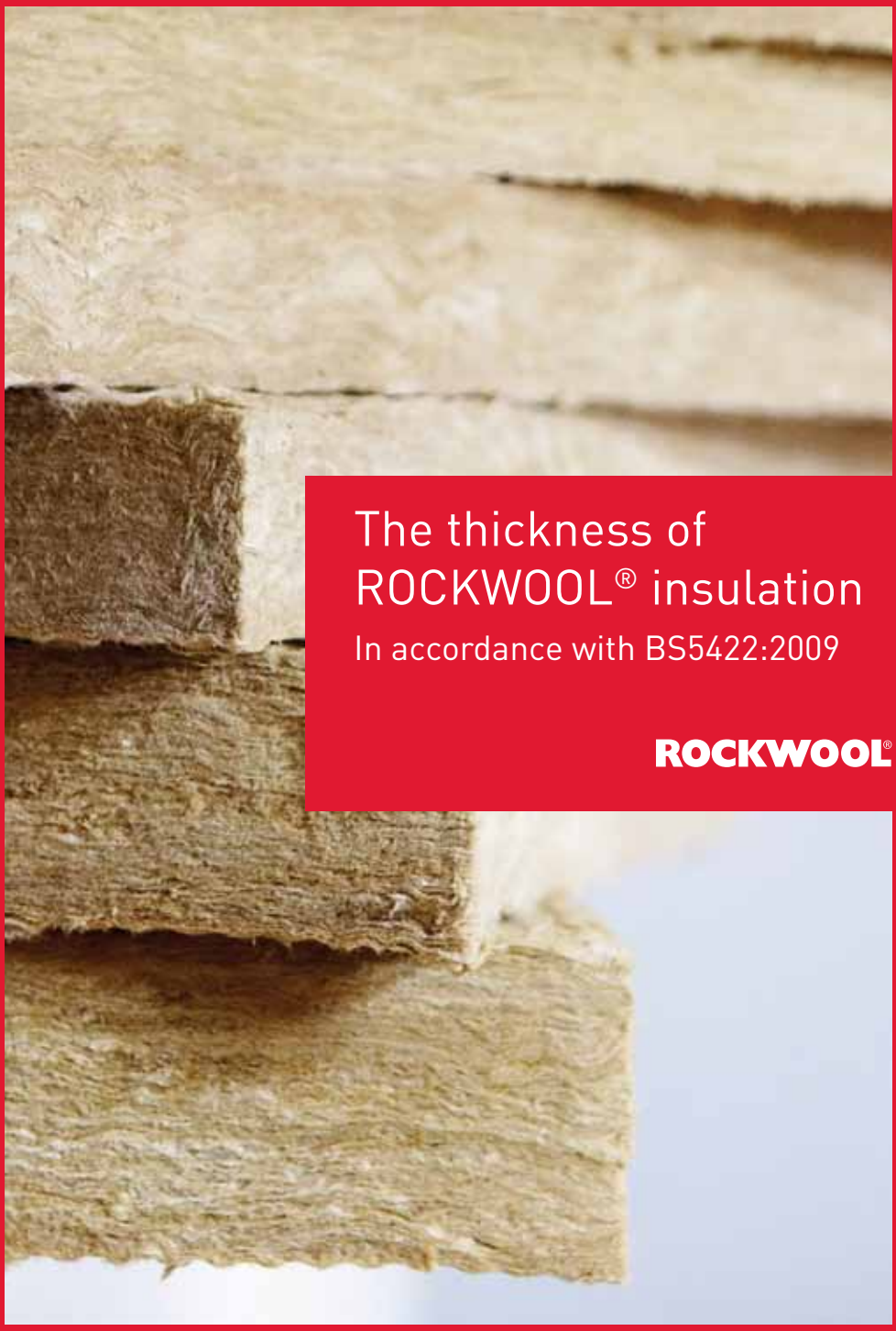

The thickness of ROCKWOOL® insulation

In accordance with BS5422:2009

ROCKWOOL®

CREATE AND PROTECT®

BS5422:2009 An explanatory note

BS5422:2009 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C

BS 5422 is arguably the most important industry-wide standard for determining and specifying the requirements for thermal insulation used on pipe-work and equipment.

Importantly, the appropriate insulation thicknesses taken from BS 5422 and used on pipe-work will be eligible for enhanced capital allowances (ECAs).

In January 2009, BS 5422:2001 was superseded by BS 5422:2009. The new version of this standard is relevant to H&V and process work undertaken on sites across the UK, although additional factors may apply to building works undertaken in accordance with the Building (Scotland) Regulations, which still refer to BS5422:2001 as outlined below.

One of the most significant changes to BS 5422 is that the thicknesses of insulation shown for pipe-work, ducts, plant and equipment are based on 'practical limits' for all applications. For H&V applications, BS 5422 has adopted the thicknesses of insulation published by TIMSA (Thermal Insulation Manufacturers and Suppliers Association) as part of its 'guidance for achieving compliance with Part L of the Building Regulations - DOMESTIC AND NON-DOMESTIC HEATING, COOLING AND VENTILATION GUIDE' (relevant to England, Wales and Northern Ireland).

Scotland
It should be noted that the Scottish Building Standards Authority (SBSA) Editions of the Technical Handbooks (Domestic & Non–Domestic) to the Building Standards (Scotland) Regulations 2004, Sections 6, Energy, still refer directly to BS 5422:2001. ROCKWOOL® does not thermally age and therefore the thicknesses shown can be relied upon to provide the required insulation performance for the lifetime of the host structure.

BS 5422 is not a prescriptive document and recognises that there are many reasons why the insulation of pipes, tanks, vessels, ductwork and equipment may be required. It is therefore important that specifiers state the criteria or specific clause or reference in this standard in any specification.

Insulation thicknesses are given for a range of thermal conductivities appropriate to the usual materials used for the application; thicknesses for intermediate thermal conductivities and pipe sizes may be deduced by calculation or interpolation. For guidance in selecting appropriate types of insulation and suitable methods of application, reference should be made to BS 5970.

Surface emissitivity (ε) table

Material	Emissivity (ε)
Aluminium, bright	0.05
Aluminium, oxidized	0.13
Aluminium foil, bright reinforced	0.05
Aluminium foil, polyester faced reinforced	0.40
Alu-zinc	0.18
Austenitic steel	0.15
Brass, dull tarnished	0.61
Brass, unoxidized	0.035
Cast iron (and iron)	0.35
Cast iron, rusted and oxidized	0.65
Chrome, polished	0.10
Cloth	0.90
Copper, commercial scoured to a shine	0.07
Copper, oxidized	0.70
Copper, polished	0.02
Fire brick	0.75
Galvanised steel, blank	0.26
Galvanised steel, dusty	0.44
Paint, black	0.95
Paint, other colours	0.90
Paint, white	0.85
Paint, aluminium weathered	0.55
Paint, aluminium new	0.30
Roofing felt	0.94
Rubber black	0.95
Rubber, grey	0.85
Steel	0.35
Steel, black painted	0.90
Steel, oxidized	0.80
White lacquer	0.95

NOTE 1 The above values provide a useful guide to surface emissivity. However, it should be noted that the emissivity of a material varies with temperature and surface finishes. Therefore, the precise emissivity should be ascertained where a high degree of accuracy is required.

Surface emissitivity

Emissivity is defined as the ratio of the energy radiated from a material's surface to that radiated from a blackbody (a perfect emitter) under the same conditions.
It is a dimensionless number between 0 (for a perfect reflector) and 1 (for a perfect emitter). The emissivity of a surface depends not only on the material but also on the nature of the surface. For example, \ a clean and polished metal surface will have a low emissivity, whereas a roughened and oxidised metal surface will have a high emissivity. The emissivity also depends on the temperature of the surface.

Knowledge of surface emissivity is important for accurate heat transfer calculations.

So what does this mean to me?
Low emissivity surfaces (e.g. aluminium, stainless steel etc.) produce a higher surface temperature but lower heat loss than high emissivity surfaces (e.g. painted steel, cloth etc.) when compared at the same operating conditions and insulation thickness.

A 273mm O.D. steam pipe running at 200°C insulated with 120mm thick ROCKWOOL® Process Pipe Section:

Cladding type	Emissivity (ε)	Other surface temp (°C)	Heat loss (W/m)
Aluminium	0.05	25.4	80
Cloth	0.90	17.0	82

Based on ambient temperature 10°C (still air), horizontal pipe.

For personnel protection applications, high emissivity claddings are best.

For heat conservation, low emissivity claddings are best.

Advice & literature

ROCKWOOL® offer a full technical advice service to assist the appropriate selection of products, their correct application and to discuss any special considerations necessary at the design stage to ensure trouble free installation and use.

For more information contact Customer Solutions & Sales Support:
0871 222 1780 www.rockwool.co.uk

Guide to tables

Table 6 (BS5422:2009)

Minimum insulation thickness for chilled and cold water steel pipes to control condensation on a high emissivity outer surface (0.9) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)		
	+10	+5	0
	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)		
17.2	8 (20)	11 (20)	14 (20)
21.3	9 (20)	12 (20)	15 (20)
26.9	9 (20)	13 (20)	16 (20)
33.7	10 (20)	13 (20)	16 (20)
42.4	10 (20)	14 (20)	17 (20)
48.3	10 (20)	14 (20)	18 (20)
60.3	11 (20)	15 (20)	18 (20)
76.1	11 (25)	15 (25)	19 (25)
88.9	12 (25)	16 (25)	20 (25)
101.6	12 (25)	16 (25)	20 (25)
114.3	12 (25)	16 (25)	21 (25)
139.7	12 (25)	17 (25)	21 (25)
168.3	13 (25)	17 (25)	22 (25)
219.1	13 (25)	18 (25)	23 (25)
244.5	13 (25)	18 (25)	23 (25)
273.0	13 (25)	18 (25)	24 (25)
323.9	13 (25)	19 (25)	24 (25)
355.6	14 (30)	19 (30)	24 (30)
406.4	14 (40)	19 (40)	25 (40)
457.0	14 (40)	20 (40)	25 (40)
508.0	14 (40)	20 (40)	25 (40)
610.0	14 (40)	20 (40)	26 (40)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

NOTE 2 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

NOTE 3 These thicknesses only apply where the vapour barrier has a dark, matt finish.

Table 7 (BS5422:2009)

Minimum insulation thickness for chilled and cold water copper pipes to control condensation on a high emissivity outer surface (0.9) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of copper pipe on which insulation has been based (mm)	Temperature of contents (°C)		
	+10	+5	0
	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)		
10	7 (size not available)	10 (size not available)	12 (size not available)
12	8 (size not available)	10 (size not available)	13 (size not available)
15	8 (size not available)	11 (size not available)	14 (size not available)
22	9 (20)	12 (20)	15 (20)
28	9 (20)	13 (20)	16 (20)
35	10 (20)	13 (20)	16 (20)
42	10 (20)	14 (20)	17 (20)
54	11 (20)	14 (20)	18 (20)
76.1	11 (25)	15 (25)	18 (25)
108	12 (25)	16 (25)	21 (25)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

NOTE 2 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

NOTE 3 These thicknesses only apply where the vapour barrier has a dark, matt finish.

Table 8 (BS5422:2009)

Minimum insulation thickness for chilled and cold water steel pipes to control condensation on a low emissivity outer surface (0.05) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)		
	+10	+5	0
	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)		
17.2	16 (20)	22 (25)	28 (30)
21.3	17 (20)	24 (25)	30 (30)
26.9	19 (20)	26 (30)	32 (35)
33.7	20 (20)	27 (30)	34 (35)
42.4	21 (25)	29 (30)	37 (40)
48.3	22 (25)	31 (35)	39 (40)
60.3	24 (25)	33 (35)	41 (45)
76.1	26 (30)	35 (35)	44 (45)
88.9	27 (30)	37 (40)	46 (50)
101.6	28 (30)	38 (40)	48 (50)
114.3	29 (30)	40 (40)	50 (50)
139.7	30 (30)	42 (45)	53 (60)
168.3	32 (35)	44 (45)	56 (60)
219.1	34 (35)	48 (50)	60 (60)
244.5	35 (35)	49 (50)	62 (70)
273.0	36 (40)	50 (50)	64 (70)
323.9	38 (40)	53 (60)	67 (70)
355.6	39 (40)	54 (60)	69 (70)
406.4	40 (40)	56 (60)	71 (80)
457.0	41 (45)	58 (60)	74 (80)
508.0	42 (45)	59 (60)	76 (80)
610.0	44 (45)	62 (70)	79 (80)
Flat	43 (50)	62 (70)	80 (80)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

NOTE 2 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 9 (BS5422:2009)

Minimum insulation thickness for chilled and cold water copper pipes to control condensation on a low emissivity outer surface (0.05) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of copper pipe on which insulation has been based (mm)	Temperature of contents (°C)		
	+10	+5	0
	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)		
10	14 (size not available)	19 (size not available)	25 (size not available)
12	15 (size not available)	20 (size not available)	25 (size not available)
15	16 (size not available)	21 (size not available)	27 (size not available)
22	18 (20)	24 (25)	30 (30)
28	19 (20)	26 (30)	33 (35)
35	20 (20)	28 (30)	35 (35)
42	21 (25)	29 (30)	37 (40)
54	23 (25)	32 (35)	40 (40)
76.1	26 (30)	35 (35)	44 (45)
108	28 (30)	39 (40)	49 (50)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

NOTE 2 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 10 (BS5422:2009)

Indicative thickness of insulation for cooled and chilled water systems to control heat gain – Low emissivity outer surfaces (ε= 0.05)

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)					
	+10		+5		0	
	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat Gain (W/m)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat Gain (W/m)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat Gain (W/m
17.2	13 (20)	2.48	17 (20)	2.97	20 (20)	3.47
21.3	14 (20)	2.72	18 (20)	3.27	21 (25)	3.81
26.9	15 (20)	3.05	20 (20)	3.58	23 (25)	4.18
33.7	16 (20)	3.41	21 (25)	4.01	25 (25)	4.60
42.4	17 (20)	3.86	22 (25)	4.53	27 (30)	5.11
48.3	18 (20)	4.11	23 (25)	4.82	28 (30)	5.45
60.3	18 (20)	4.78	24 (25)	5.48	29 (30)	6.17
76.1	19 (25)	5.51	25 (25)	6.30	33 (35)	6.70
88.9	19 (25)	6.17	26 (30)	6.90	31 (35)	7.77
114.3	20 (25)	7.28	26 (30)	8.31	32 (35)	9.15
139.7	20 (25)	8.52	27 (30)	9.49	33 (35)	10.45
168.3	20 (25)	9.89	27 (30)	10.97	34 (35)	11.86
219.1	21 (25)	12.27	28 (30)	13.57	35 (35)	14.61
273.0	21 (25)	14.74	28 (30)	16.28	35 (35)	17.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 25°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Thicknesses derived solely against the criteria noted in this table may not necessarily satisfy other design requirements such as control of condensation.
NOTE 3 Heat gain relates to the specified thickness and temperature.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 11 (BS5422:2009)

Indicative thickness of insulation for cooled and chilled water systems to control heat gain – High emissivity outer surfaces (ε= 0.9)

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)					
	+10		+5		0	
	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat Gain (W/m)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat Gain (W/m)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat Gain (W/m
17.2	18 (20)	2.48	22 (25)	2.97	26 (30)	3.47
21.3	19 (20)	2.72	23 (25)	3.27	27 (30)	3.81
26.9	20 (20)	3.05	26 (30)	3.58	29 (30)	4.18
33.7	21 (25)	3.41	27 (30)	4.01	31 (35)	4.60
42.4	22 (25)	3.86	28 (30)	4.53	33 (35)	5.11
48.3	24 (25)	4.11	29 (30)	4.82	34 (35)	5.45
60.3	24 (25)	4.78	31 (35)	5.48	36 (40)	6.17
76.1	25 (25)	5.51	31 (35)	6.30	40 (40)	6.70
88.9	25 (25)	6.17	33 (35)	6.90	38 (40)	7.77
114.3	27 (30)	7.28	33 (35)	8.31	39 (40)	9.15
139.7	27 (30)	8.52	34 (35)	9.49	41 (45)	10.45
168.3	27 (30)	9.89	35 (35)	10.97	42 (45)	11.86
219.1	28 (30)	12.27	35 (35)	13.57	42 (45)	14.61
273.0	28 (30)	14.74	36 (40)	16.28	43 (45)	17.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 25°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Thicknesses derived solely against the criteria noted in this table may not necessarily satisfy other design requirements such as control of condensation.
NOTE 3 Heat gain relates to the specified thickness and temperature.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 12 (BS5422:2009)

Minimum insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions: indoor still air temperature +25°C, relative humidity 80%, dewpoint temperature 21.3°C

Minimum temperature inside duct (°C)	External surface emissivity		
	0.05 (eg bright aluminium foil)	0.44 (eg dusty galvanised steel)	0.90 (eg black paint)
	Minimum thickness of ROCKWOOL® Ductwrap (mm)		
15	25 (25)	13 (25)	8 (25)
10	44 (50)	23 (25)	15 (25)
5	63 (65)	32 (40)	20 (25)
0	81 (90)	41 (50)	26 (30)

NOTE 1 Thicknesses given are calculated in accordance with BS EN ISO 12241:1998 based on 0.6m vertical flat surface of rectangular duct but are also adequate for horizontal surfaces.
NOTE 2 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.
NOTE 3 Refer to Annex B, Table B. 1 for surface emissivities of common finishing materials. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 13 (BS5422:2009)

Indicative thickness of insulation for ductwork carrying warm air to control heat loss.

Emissivity 0.05 (eg bright aluminium foil)	Emissivity 0.44 (eg dusty galvanised steel)	Emissivity 0.90 (eg black paint)
	Maximum permissable heat loss	
16.34 W/m^2	16.34 W/m^2	16.34 W/m^2
31mm (40mm)	36mm (40mm)	38mm (40mm)

NOTE 1 Heat loss relates to the specified thickness and temperature.
NOTE 2 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal duct at 35°C, with 600 mm vertical sidewall in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 3 Advised thicknesses of ROCKWOOL® Ductwrap/Ductslab insulation are shown in brackets.

Table 14 (BS5422:2009)

Indicative thickness of insulation for chilled and dual-purpose ducting to control heat transfer

Emissivity 0.05 (eg bright aluminium foil)	Emissivity 0.44 (eg dusty galvanised steel)	Emissivity 0.90 (eg black paint)
	Maximum permissable heat loss	
6.45 W/m^2	6.45 W/m^2	6.45 W/m^2
49mm (50mm)	56mm (60mm)	59mm (60mm)

NOTE 1 Heat loss relates to the specified thickness and temperature.
NOTE 2 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal duct at 13°C, with 600mm vertical sidewall in still air at 25°C, emissivity of outer surface of insulated system as specified.
NOTE 3 Advised thicknesses of ROCKWOOL® Ductwrap/Ductslab insulation are shown in brackets.

Table 15 (BS5422:2009)

Indicative thickness of insulation for non-domestic heating services to control heat loss – low emissivity outer surfaces (ε=0.05)

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C) 75 Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Max heat loss (W/m)	100 Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Max heat loss (W/m)	125 Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Max heat loss (W/m)
17.2	24 (25)	8.90	24 (25)	13.34	25 (25)	17.92
21.3	29 (30)	9.28	30 (30)	13.56	30 (30)	18.32
26.9	31 (35)	10.06	37 (40)	13.83	38 (40)	18.70
33.7	33 (35)	11.07	44 (45)	14.39	47 (50)	19.02
42.4	35 (35)	12.30	48 (50)	15.66	59 (60)	19.25
48.3	37 (40)	12.94	49 (50)	16.67	61 (70)	20.17
60.3	39 (40)	14.45	53 (60)	18.25	66 (70)	21.96
76.1	41 (45)	16.35	56 (60)	20.42	71 (80)	24.21
88.9	42 (45)	17.91	58 (60)	22.09	74 (80)	25.99
114.3	45 (45)	20.77	61 (70)	25.31	79 (80)	29.32
139.7	46 (50)	23.71	64 (70)	28.23	83 (90)	32.47
168.3	47 (50)	26.89	66 (70)	31.61	86 (90)	36.04
219.1	48 (50)	32.54	68 (70)	37.66	90 (90)	42.16
273.0	48 (50)	38.83	71 (80)	43.72	94 (100)	48.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Heat loss relates to the specified thickness and temperature.
NOTE 3 The thicknesses in this table are applicable to pipes serving commercial solar hot water panels.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 16 (BS5422:2009)

Indicative thickness of insulation for non-domestic heating services to control heat loss – High emissivity outer surfaces (ε= 0.9)

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C) 75 Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Max heat loss (W/m)	100 Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Max heat loss (W/m)	125 Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Max heat loss (W/m)
17.2	28 (30)	8.90	28 (30)	13.34	28 (30)	17.92
21.3	33 (35)	9.28	34 (35)	13.56	34 (40)	18.32
26.9	36 (40)	10.06	42 (45)	13.83	42 (45)	18.70
33.7	38 (40)	11.07	49 (50)	14.39	51 (60)	19.02
42.4	40 (40)	12.30	52 (60)	15.66	63 (70)	19.25
48.3	42 (45)	12.94	54 (60)	16.67	66 (70)	20.17
60.3	44 (45)	14.45	58 (60)	18.25	71 (80)	21.96
76.1	47 (50)	16.35	61 (70)	20.42	76 (80)	24.21
88.9	48 (50)	17.91	63 (70)	22.09	79 (80)	25.99
114.3	50 (50)	20.77	66 (70)	25.31	84 (90)	29.32
139.7	51 (60)	23.71	70 (80)	28.23	89 (90)	32.47
168.3	53 (60)	26.89	72 (80)	31.61	92 (100)	36.04
219.1	54 (60)	32.54	74 (80)	37.66	96 (100)	42.16
273.0	54 (60)	38.83	77 (80)	43.72	100 (100)	48.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Heat loss relates to the specified thickness and temperature.
NOTE 3 The thicknesses in this table are applicable to pipes serving commercial solar hot water panels.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 17 (BS5422:2009)

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss – Low emissivity outer surfaces

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat loss (W/m)
17.2	23 (25)	6.60
21.3	25 (25)	7.13
26.9	27 (30)	7.83
33.7	29 (30)	8.62
42.4	30 (30)	9.72
48.3	32 (35)	10.21
60.3	33 (35)	11.57
76.1	35 (35)	13.09
88.9	35 (35)	14.58
114.3	36 (40)	17.20
139.7	37 (40)	19.65
168.3	38 (40)	22.31
219.1	38 (40)	27.52
273.0	39 (40)	32.40

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Heat loss relates to the specified thickness and temperature.
NOTE 3 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 18 (BS5422:2009)

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss – high emissivity outer surfaces

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat loss (W/m)
17.2	27 (30)	6.60
21.3	29 (30)	7.13
26.9	31 (35)	7.83
33.7	33 (35)	8.62
42.4	34 (35)	9.72
48.3	37 (40)	10.21
60.3	38 (40)	11.57
76.1	40 (40)	13.09
88.9	41 (45)	14.58
114.3	41 (45)	17.20
139.7	43 (45)	19.65
168.3	44 (45)	22.31
219.1	44 (45)	27.52
273.0	46 (50)	32.40

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Heat loss relates to the specified thickness and temperature.
NOTE 3 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 19 (BS5422:2009)

Indicative thickness of insulation for domestic heating and hot water systems having low emissivity outer surfaces

Outside diameter of copper pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat loss (W/m)
8.0	6 (size not available)	7.06
10.0	9 (size not available)	7.23
12.0	11 (size not available)	7.35
15.0	12 (size not available)	7.89
22.0	15 (20)	9.12
28.0	16 (20)	10.07
35.0	18 (20)	11.08
42.0	19 (20)	12.19
54.0	20 (20)	14.12

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Heat loss relates to the specified thickness and temperature.
NOTE 3 This table is applicable to pipes serving solar hot water panels.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 20 (BS5422:2009)

Indicative thickness of insulation for domestic heating and hot water systems having high emissivity outer surfaces

Outside diameter of copper pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL® Rocklap H&V Pipe Section (mm)	Heat loss (W/m)
8.0	9 (size not available)	7.06
10.0	12 (size not available)	7.23
12.0	14 (size not available)	7.35
15.0	16 (size not available)	7.89
22.0	18 (20)	9.12
28.0	21 (25)	10.07
35.0	22 (25)	11.08
42.0	23 (25)	12.19
54.0	24 (25)	14.12

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.
NOTE 2 Heat loss relates to the specified thickness and temperature.
NOTE 3 This table is applicable to pipes serving solar hot water panels.
NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 21 (BS5422:2009)

Minimum insulation thickness for process pipework and equipment to control heat loss

Diameter of steel pipe on which insulation has been based mm	Hot face temperature (°C)													
	100		200		300		400		500		600		700	
	Ins thk mm	Heat loss W/m	Ins thk mm	Heat loss W/m	Ins thk mm	Heat loss W/m	Ins thk mm	Heat loss W/m	Ins thk mm	Heat loss W/m	Ins thk mm	Heat loss W/m	Ins thk mm	Heat loss W/m
17.2	23	12.8	36	28.7	47	47.1	59	69.1	69	96.1	81	126.9	93	163.6
21.3	24	14.0	38	30.7	50	50.5	62	74.1	72	103.0	86	135.4	97	174.5
26.9	26	15.4	41	33.7	54	55.0	66	80.1	77	110.7	91	145.6	103	186.9
33.7	27	17.3	43	37.1	56	59.9	69	87.2	82	119.8	96	156.8	109	201.2
42.4	29	19.2	46	40.8	60	65.8	73	95.1	86	130.6	101	170.0	115	217.3
48.3	30	20.4	47	43.4	62	69.4	76	99.7	89	137.0	104	178.3	118	227.8
60.3	31	23.2	49	48.4	65	76.7	80	109.9	94	149.3	109	194.3	124	247.2
76.1	33	26.2	52	54.2	69	85.1	85	121.2	99	164.6	116	213.2	131	270.2
88.9	34	28.7	54	58.7	71	92.0	88	130.2	102	176.7	120	227.7	136	288.4
114.3	35	33.9	57	67.3	75	104.6	93	146.8	108	198.2	127	254.2	144	320.7
139.7	36	38.7	59	75.7	78	116.6	96	163.6	113	218.2	132	279.8	150	351.4
168.3	37	44.0	61	84.9	81	129.5	100	180.4	118	240.5	138	305.5	157	383.8
219.1	38	53.4	63	101.2	84	152.7	105	209.6	124	277.8	146	351.0	166	437.2
273.0	39	62.9	65	117.6	87	175.7	110	239.4	129	315.4	158	386.9	172	495.1

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.
NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.
NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.
NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.
NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).

Table 22 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a non-metallic surface with a surface emissivity of 0.90 and design cold face temperature of 59°C

Outside diameter of steel pipe (mm)	Surface emissivity 0.9 (eg black paint) Non-metallic surface Design cold face 59°C						
	Hot face temperature (°C) with ambient still air at +20°C						
	100	200	300	400	500	600	700
	Thickness of ROCKWOOL® Process Pipe Section (mm)						
17.2	3	10	17	26	36	48	61
21.3	3	10	18	27	38	50	65
26.9	3	11	19	29	40	54	69
33.7	3	11	20	31	43	57	73
42.4	4	12	21	33	45	60	78
48.3	4	12	22	34	47	63	80
60.3	4	13	23	35	50	66	85
76.1	4	13	24	37	53	70	90
88.9	4	14	25	39	55	73	94
101.6	4	14	26	40	57	76	97
114.3	4	14	27	41	58	78	100
139.7	4	15	28	43	61	82	105
168.3	4	15	29	45	63	85	110
219.1	4	16	30	47	67	90	117
244.5	4	16	30	48	69	93	120
273.0	5	16	31	49	70	95	123
323.9	5	17	32	50	72	98	128
355.6	5	17	32	51	74	100	130
406.4	5	17	33	52	75	103	130
457.0	5	17	33	53	77	103	130
508.0	5	17	34	54	77	103	131
610.0	5	17	34	54	77	103	134
flat	5	18	35	58	87	122	166

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.
NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.
NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.
NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.
NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).
NOTE 6 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 23 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.05 and design cold face temperature of 50°C

Outside diameter of steel pipe (mm)	Surface emissivity 0.05 (eg bright aluminium foil) Metallic surface Design cold face 50°C						
	Hot face temperature (°C) with ambient still air at +20°C						
	100	200	300	400	500	600	700
	Thickness of ROCKWOOL® Process Pipe Section (mm)						
17.2	7	22	40	62	90	124	165
21.3	8	24	43	66	96	131	175
26.9	8	25	46	71	102	140	186
33.7	9	27	49	76	109	150	198
42.4	10	29	53	82	117	160	211
48.3	10	30	55	85	122	166	219
60.3	11	33	59	91	130	178	234
76.1	11	35	63	98	140	191	251
88.9	12	37	67	103	147	200	263
101.6	12	38	69	107	153	208	273
114.3	12	39	72	111	159	216	283
139.7	13	42	76	119	169	230	283
168.3	14	44	81	126	179	243	283
219.1	15	47	88	136	195	243	295
244.5	15	49	90	141	201	243	302
273.0	15	50	93	146	208	244	309
323.9	16	53	98	153	208	253	321
355.6	16	54	101	158	208	257	327
406.4	17	56	105	158	208	264	337
457.0	17	58	108	158	208	270	345
508.0	18	60	108	158	208	276	352
610.0	19	60	108	158	214	285	365
flat	19	62	121	197	294	414	561

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.
NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.
NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.
NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.
NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).
NOTE 6 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 24 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a non-metallic surface with a surface emissivity of 0.90 and design cold face temperature of 50°C

Outside diameter of steel pipe (mm)	Surface emissivity 0.09 (eg black paint) Metallic surface Design cold face 50°C						
	Hot face temperature (°C) with ambient still air at +20°C						
	100	200	300	400	500	600	700
	Thickness of ROCKWOOL® Process Pipe Section (mm)						
17.2	5	13	23	34	47	62	80
21.3	5	14	24	36	50	66	84
26.9	5	15	25	38	53	70	90
33.7	5	15	27	40	56	74	95
42.4	5	16	28	43	59	79	101
48.3	6	17	29	44	61	81	104
60.3	6	17	31	47	65	86	110
76.1	6	18	33	49	69	91	117
88.9	6	19	34	51	72	95	122
101.6	6	19	35	53	74	98	126
114.3	6	20	36	54	76	101	130
139.7	7	20	37	57	80	107	137
168.3	7	21	39	59	84	111	143
219.1	7	22	40	63	89	119	153
244.5	7	22	41	64	91	122	157
273.0	7	23	42	65	93	125	161
323.9	7	23	43	67	96	129	168
355.6	7	24	44	69	98	132	168
406.4	7	24	45	70	100	136	168
457.0	7	24	46	72	103	136	170
508.0	8	25	46	73	103	136	173
610.0	8	25	46	73	103	137	178
flat	8	25	49	80	119	168	227

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.
NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.
NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.
NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.
NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).
NOTE 6 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.05 and design cold face temperature of 55°C

Outside diameter of steel pipe (mm)	Surface emissivity 0.05 (eg bright aluminium foil) Metallic surface Design cold face 55°C Hot face temperature (°C) with ambient still air at +20°C						
	100	200	300	400	500	600	700
	Thickness of ROCKWOOL® Process Pipe Section (mm)						
17.2	6	18	33	52	75	103	137
21.3	6	20	36	55	80	110	146
26.9	7	21	38	60	86	117	155
33.7	7	22	41	64	92	125	166
42.4	7	24	44	69	98	134	177
48.3	8	25	46	71	102	140	184
60.3	8	27	49	76	110	149	196
76.1	9	29	53	82	118	160	211
88.9	9	30	55	86	124	168	221
101.6	9	31	58	90	129	175	230
114.3	10	32	60	93	134	182	238
139.7	10	34	64	99	142	193	253
168.3	10	36	67	105	151	205	253
219.1	11	39	73	114	163	205	253
244.5	11	40	75	118	169	205	257
273.0	12	41	78	122	175	207	263
323.9	12	43	81	128	175	214	273
355.6	12	44	84	132	175	218	278
406.4	13	46	87	132	175	224	286
457.0	13	47	90	132	175	229	293
508.0	14	48	90	132	175	233	299
610.0	14	48	90	132	180	241	309
flat	14	50	99	162	242	342	463

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table, Adopting these thicknesses may not necessarily satisfy other design requirements.

NOTE 2 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.18 and design cold face temperature of 55°C

Outside diameter of steel pipe (mm)	Surface emissivity 0.18 (eg alu-zinc cladding) Metallic surface Design cold face 55°C Hot face temperature (°C) with ambient still air at +20°C						
	100	200	300	400	500	600	700
	Thickness of ROCKWOOL® Process Pipe Section (mm)						
17.2	5	16	30	46	65	89	117
21.3	6	17	32	49	69	94	123
26.9	6	19	34	52	74	100	132
33.7	6	20	36	56	79	107	140
42.4	7	21	39	60	84	114	149
48.3	7	22	40	62	88	119	155
60.3	7	24	43	66	94	127	165
76.1	8	25	46	71	100	135	177
88.9	8	26	48	74	105	142	185
101.6	8	27	50	77	109	147	192
114.3	8	28	51	80	113	153	199
139.7	9	29	54	84	120	162	211
168.3	9	31	57	89	127	171	222
219.1	9	33	61	89	137	184	222
244.5	10	34	63	99	141	190	222
273.0	10	35	65	102	145	190	227
323.9	10	36	68	106	152	190	235
355.6	10	37	69	109	152	190	240
406.4	11	38	72	113	152	192	246
457.0	11	39	74	113	152	196	252
508.0	11	40	76	113	152	200	257
610.0	12	40	76	113	153	206	265
flat	12	41	81	133	198	279	379

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table, Adopting these thicknesses may not necessarily satisfy other design requirements.

NOTE 2 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.26 and design cold face temperature of 55°C

Outside diameter of steel pipe (mm)	Surface emissivity 0.26 (eg new galvanized cladding) Metallic surface Design cold face 55°C						
	Hot face temperature (°C) with ambient still air at +20°C						
	100	200	300	400	500	600	700
	Thickness of ROCKWOOL® Process Pipe Section (mm)						
17.2	5	16	28	43	60	82	107
21.3	5	16	30	45	64	87	113
26.9	6	18	32	48	69	93	121
33.7	6	19	34	52	73	99	128
42.4	6	20	36	55	78	105	137
48.3	6	21	37	57	81	109	142
60.3	7	22	40	61	86	116	151
76.1	7	23	43	65	92	124	161
88.9	7	24	44	68	97	130	169
101.6	8	25	46	71	100	135	175
114.3	8	26	47	73	104	140	181
139.7	8	27	50	77	110	148	192
168.3	8	28	52	81	116	156	202
219.1	9	30	56	87	124	168	218
244.5	9	31	58	90	128	173	218
273.0	9	32	59	92	132	178	218
323.9	9	33	62	97	138	178	218
355.6	9	33	63	99	141	178	221
406.4	10	34	65	102	141	178	227
457.0	10	35	66	102	141	181	232
508.0	10	36	68	102	141	184	236
610.0	10	36	68	102	141	189	244
flat	10	37	73	119	178	251	341

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table, Adopting these thicknesses may not necessarily satisfy other design requirements.

NOTE 2 To simplify the use of this table the values shaded have been adjusted to avoid thespecification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 25 (BS5422:2009)

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241:1998 (black steel pipes)

Outside diameter of steel pipe mm	Operating temperature (°C)													
	50	100	150	200	250	300	350	400	450	500	550	600	650	700
	Heat loss (W/m pipes, W/m² flat)													
12.0	17	57	110	176	257	356	476	620	791	993	1231	1509	1832	2206
15.0	20	69	133	214	313	435	582	758	969	1220	1514	1859	2260	2723
17.2	23	78	150	241	353	491	658	859	1099	1384	1720	2113	2571	3100
21.3	27	93	180	290	427	594	798	1043	1337	1687	2099	2583	3146	3798
22.0	28	96	186	299	439	611	821	1074	1378	1738	2164	2662	3243	3916
26.9	33	114	221	356	525	732	985	1291	1658	2095	2611	3217	3923	4742
28.0	35	118	229	369	544	759	1022	1340	1721	2175	2711	3341	4075	4926
33.7	41	139	269	435	641	897	1209	1588	2042	2585	3226	3979	4859	5878
42.0	49	168	326	528	781	1094	1478	1944	2505	3175	3968	4901	5990	7254
42.4	50	169	329	532	788	1104	1491	1961	2527	3203	4004	4945	6045	7320
48.3	56	190	369	598	885	1242	1679	2212	2853	3619	4527	5595	6843	8292
54.0	61	209	407	660	979	1374	1860	2452	3165	4018	5029	6220	7612	9220
60.3	68	230	448	728	1081	1519	2058	2715	3508	4456	5582	6908	8458	10258
67.0	74	253	492	800	1188	1672	2268	2994	3871	4921	6167	7636	9354	11350
76.1	83	283	551	896	1333	1878	2550	3370	4360	5548	6958	8621	10566	12827
80.0	87	295	576	938	1395	1966	2670	3530	4569	5815	7296	9041	11084	13459
88.9	95	324	632	1031	1535	2165	2943	3894	5044	6424	8064	9998	12263	14897
101.6	107	365	712	1162	1733	2447	3330	4410	5718	7287	9155	11358	13940	16942
108.0	113	385	752	1228	1832	2588	3523	4668	6056	7721	9703	12042	14782	17969
114.3	119	405	791	1292	1929	2726	3714	4922	6387	8147	10241	12713	15609	18979
139.7	142	484	947	1549	2316	3279	4474	5939	7716	9853	12399	15406	18932	23036
168.3	167	571	1119	1833	2746	3894	5321	7072	9200	11760	14812	18420	22653	27582
219.1	212	722	1419	2330	3498	4971	6806	9063	11809	15117	19065	23736	29220	35609
273.0	258	880	1731	2848	4283	6098	8362	11152	14550	18647	24221	30135	37067	45134
323.9	301	1027	2021	3331	5061	7151	10254	13667	17813	22798	28737	35754	43978	53549
flat	285	1212	2405	3949	5897	8317	11286	14890	19226	24396	30515	37700	46081	55794

Operating conditions:
Ambient still air: 20°C
Surface emissivity: 0.90
Height of flat surfaces: 0.6m
Surface orientation: horizontal

Table 26 (BS5422:2009)

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241:1998 (copper pipes – commercial grade, scoured to a shine)

Outside diameter of pipe (mm)	Operating temperature (°C) 50	100	150	200
	Heat loss (W/m pipes, W/m² flat)			
12.0	11	36	66	100
15.0	12	43	79	119
17.2	14	47	87	132
21.3	16	56	103	156
22.0	17	57	105	160
26.9	19	66	123	186
28.0	20	69	127	192
33.7	23	79	146	222
42.0	27	93	173	263
42.4	28	94	174	265
48.3	31	104	192	292
54.0	33	113	210	319
60.3	36	123	228	347
67.0	39	134	248	377
76.1	43	148	273	416
80.0	45	153	284	432
88.9	49	166	308	469
101.6	54	184	341	520
108.0	57	193	358	545
114.3	59	202	374	570
139.7	69	236	437	666
168.3	80	272	505	770
219.1	98	334	619	946
273.0	116	396	735	1123
323.9	133	452	840	1284
flat	119	647	1244	1938

Operating conditions:
Ambient still air: 20°C
Surface emissivity: 0.07
Height of flat surfaces: 0.6m
Surface orientation: horizontal

Table 27 (BS5422:2009)

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241 (copper pipes – oxidised)

Outside diameter of pipe (mm)	Operating temperature (°C) 50	100	150	200
	Heat loss (W/m pipes, W/m² flat)			
12.0	15	52	99	158
15.0	18	63	120	191
17.2	21	70	135	215
21.3	25	84	162	258
22.0	25	87	166	265
26.9	30	103	197	315
28.0	31	106	204	326
33.7	36	124	239	383
42.0	44	150	289	464
42.4	44	151	292	464
48.3	50	169	326	524
54.0	55	186	359	578
60.3	60	205	395	636
67.0	66	224	433	698
76.1	73	250	484	781
80.0	77	261	505	816
88.9	84	286	554	895
101.6	94	321	623	1007
108.0	99	339	657	1063
114.3	104	356	691	1118
139.7	124	424	824	1336
168.3	146	499	971	1577
219.1	184	629	1226	1997
273.0	224	763	1491	2432
323.9	261	888	1737	2837
flat	245	1076	2125	3464

Operating conditions:
Ambient still air: 20°C
Surface emissivity: 0.70
Height of flat surfaces: 0.6m
Surface orientation: horizontal

Table 28 (BS5422:2009)

Minimum insulation thickness to protect steel pipes against freezing under selected industrial process conditions

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Initial temperature: +5°C Minimum ambient air temperature: -10°C Evaluation period: 12 hours Permitted ice formation nil Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)	Initial temperature: +5°C Minimum ambient air temperature: -10°C Evaluation period: 12 hours Permitted ice formation 10% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)
21.3	16.0	- (-)	- (-)
26.9	21.6	- (-)	873 (-)
33.7	27.2	- (-)	222 (-)
42.4	35.9	863 (-)	82 (-)
48.3	41.8	398 (-)	55 (60)
60.3	53.0	158 (-)	34 (35)
76.1	68.8	81 (85)	22 (25)
88.9	80.8	58 (60)	18 (25)
114.3	105.3	38 (40)	13 (25)
168.3	158.6	22 (25)	8 (25)
219.1	207.9	16 (25)	6 (25)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (CP) are as follows:
— ρ water = 1 000 kg/m³, CP water = 4 200 J/kg K;
— ρ steel = 7 840 kg/m³, CP steel = 455 J/kg K.

NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 29 (BS5422:2009)

Minimum insulation thickness required to give protection against freezing under specified commercial and institutional conditions

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Initial temperature: +2°C Minimum ambient air temperature: -6°C (indoor unheated) Evaluation period: 12 hours Permitted ice formation 50% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)	Initial temperature: +2°C Minimum ambient air temperature: -10°C (outdoor) Evaluation period: 12 hours Permitted ice formation 50% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)
Copper pipes			
15.0	13.6	59 (size not available)	269 (size not available)
22.0	20.2	19 (20)	46 (50)
28.0	26.2	12 (20)	24 (25)
35.0	32.6	9 (20)	16 (20)
42.0	39.6	7 (20)	12 (20)
54.0	51.6	5 (20)	8 (20)
76.1	73.1	4 (25)	6 (25)
108.0	105.0	3 (25)	4 (25)
Steel pipes			
21.3	16.0	40 (40)	126 (-)
26.9	21.6	19 (20)	42 (45)
33.7	27.2	13 (20)	25 (25)
42.4	35.9	8 (20)	15 (20)
48.3	41.8	7 (20)	12 (20)
60.3	53.0	5 (20)	9 (20)
76.1	68.8	4 (25)	6 (25)
88.9	80.8	3 (25)	5 (25)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (CP) are as follows:
— ρ water = 1 000 kg/m³, CP water = 4 200 J/kg K;
— ρ steel = 7 840 kg/m³, CP steel = 455 J/kg K.

NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 30 (BS5422:2009)

Minimum insulation thickness to protect against freezing for domestic cold water systems [12 h]

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Normal installation inside the building inside the envelope of the insulation Initial temperature +7°C Minimum ambient air temperature -6°C Evaluation period 12 hours Permitted ice formation 50% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)	Normal installation inside the building inside the envelope of the insulation Initial temperature +2°C Minimum ambient air temperature -6°C Evaluation period 12 hours Permitted ice formation 50% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)
Copper pipes			
15.0	13.6	49 (size not available)	59 (size not available)
22.0	20.2	17 (20)	19 (20)
28.0	26.2	11 (20)	12 (20)
35.0	32.6	8 (20)	9 (20)
42.0	39.6	6 (20)	7 (20)
54.0	51.6	5 (20)	5 (20)
76.1	73.1	3 (25)	4 (25)
108.0	105.0	2 (25)	3 (25)
Steel pipes			
21.3	16.0	32 (40)	40 (40)
26.9	21.6	16 (20)	19 (20)
33.7	27.2	11 (20)	13 (20)
42.4	35.9	7 (20)	8 (20)
48.3	41.8	6 (20)	7 (20)
60.3	53.0	5 (20)	5 (20)
76.1	68.8	4 (25)	4 (25)
88.9	80.8	3 (25)	3 (25)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (CP) are as follows:
— ρ water = 1 000 kg/m³, CP water = 4 200 J/kg K;
— ρ steel = 7 840 kg/m³, CP steel = 455 J/kg K.

NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Table 31 (BS5422:2009)

Minimum insulation thickness to protect against freezing for domestic cold water systems [8 h]

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Normal installation inside the building inside the envelope of the insulation Initial temperature +7°C Minimum ambient air temperature -6°C Evaluation period 8 hours Permitted ice formation 50% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)	Normal installation inside the building inside the envelope of the insulation Initial temperature +2°C Minimum ambient air temperature -6°C Evaluation period 8 hours Permitted ice formation 50% Thickness of ROCKWOOL® Pipe Section (H&V or process) (mm)
Copper pipes			
15.0	13.6	22 (size not available)	25 (size not available)
22.0	20.2	10 (20)	11 (20)
28.0	26.2	7 (20)	7 (20)
35.0	32.6	5 (20)	6 (20)
42.0	39.6	4 (20)	4 (20)
54.0	51.6	3 (20)	3 (20)
76.1	73.1	2 (25)	2 (25)
108.0	105.0	2 (25)	2 (25)
Steel pipes			
21.3	16.0	17 (20)	20 (40)
26.9	21.6	10 (20)	11 (20)
33.7	27.2	7 (20)	8 (20)
42.4	35.9	5 (20)	5 (20)
48.3	41.8	4 (20)	5 (20)
60.3	53.0	3 (20)	4 (20)
76.1	68.8	3 (25)	3 (25)
88.9	80.8	2 (25)	2 (25)

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (CP) are as follows:
— ρ water = 1 000 kg/m³, CP water = 4 200 J/kg K;
— ρ steel = 7 840 kg/m³, CP steel = 455 J/kg K.

NOTE 4 Advised thicknesses of ROCKWOOL® insulation are shown in brackets.

Health and Safety

In accordance with REACH health and environment regulations, there are no hazardous classifications associated with ROCKWOOL® mineral wool in respect to physical, health and environmental considerations.

More information

ROCKWOOL® Limited reserves the right to alter or amend the specification of products without notice as our policy is one of constant improvement. The information contained in this data sheet is believed to be correct at the date of publication.

Interested?

For further information, contact the Customer Solutions & Sales Support on 0871 222 1780 or email info@rockwool.co.uk

Visit www.rockwool.co.uk to view our complete range of products and services.

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